Mod 6 – Ethernet Fundamentals

Full-Duplex

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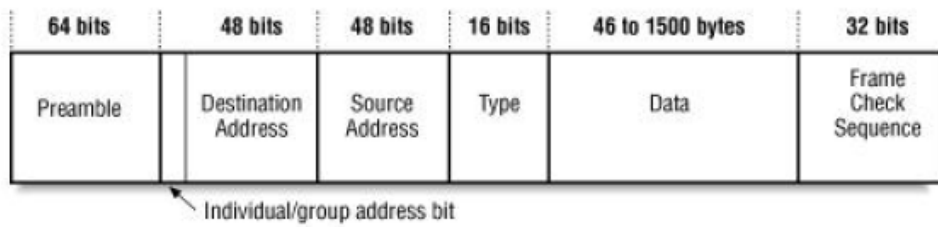
CIS 81 and CST 311

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Note to instructors

- If you have downloaded this presentation from the Cisco Networking Academy Community FTP Center, this may not be my latest version of this PowerPoint.

- For the latest PowerPoints for all my CCNA, CCNP, and Wireless classes, please go to my web site:

  http://www.cabrillo.edu/~rgraziani/

  - The username is *cisco* and the password is *perlman* for all of my materials.

- If you have any questions on any of my materials or the curriculum, please feel free to email me at graziani@cabrillo.edu   (I really don't mind helping.) Also, if you run across any typos or errors in my presentations, please let me know.

- I will add "(Updated – *date*)" next to each presentation on my web site that has been updated since these have been uploaded to the FTP center.
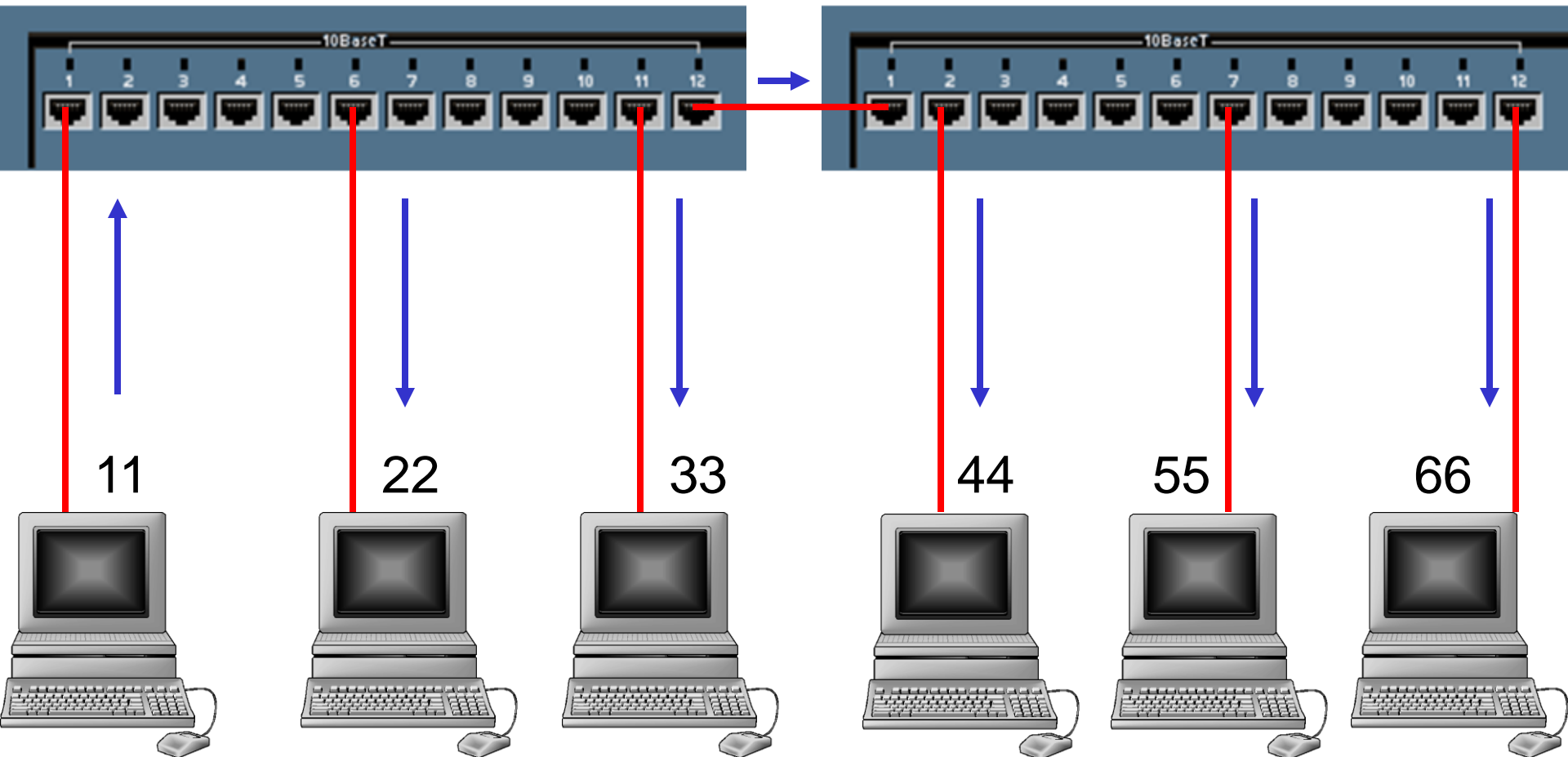
Thanks! Rick

| 64 bits	48 bits	48 bits	16 bits	46 to 1500 bytes	32 bits
Preamble	Destination Address	Source Address	Type	Data	Frame Check Sequence

Individual/group address bit

Half-duplex CSMA/CD

Hub

Hub

11   22   33   44   55   66

Source Address Table				Source Address Table			
Port	Source MAC Add.	Port	Source MAC Add.	Port	Source MAC Add.	Port	Source MAC Add.

Full-duplex
No CSMA/CD

Switch   Switch
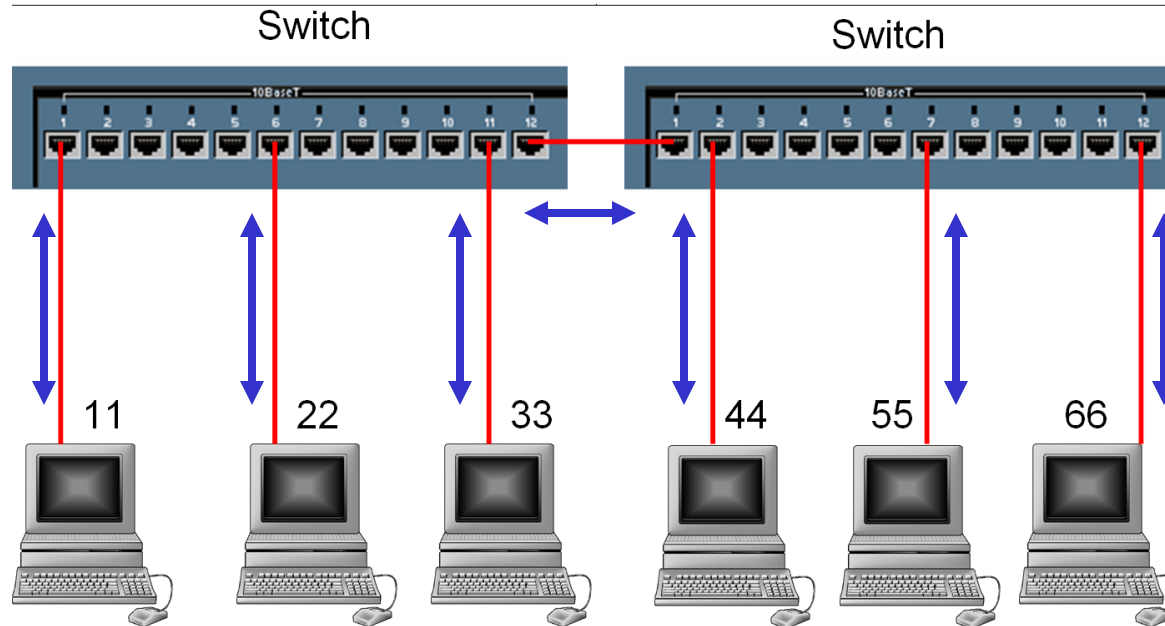

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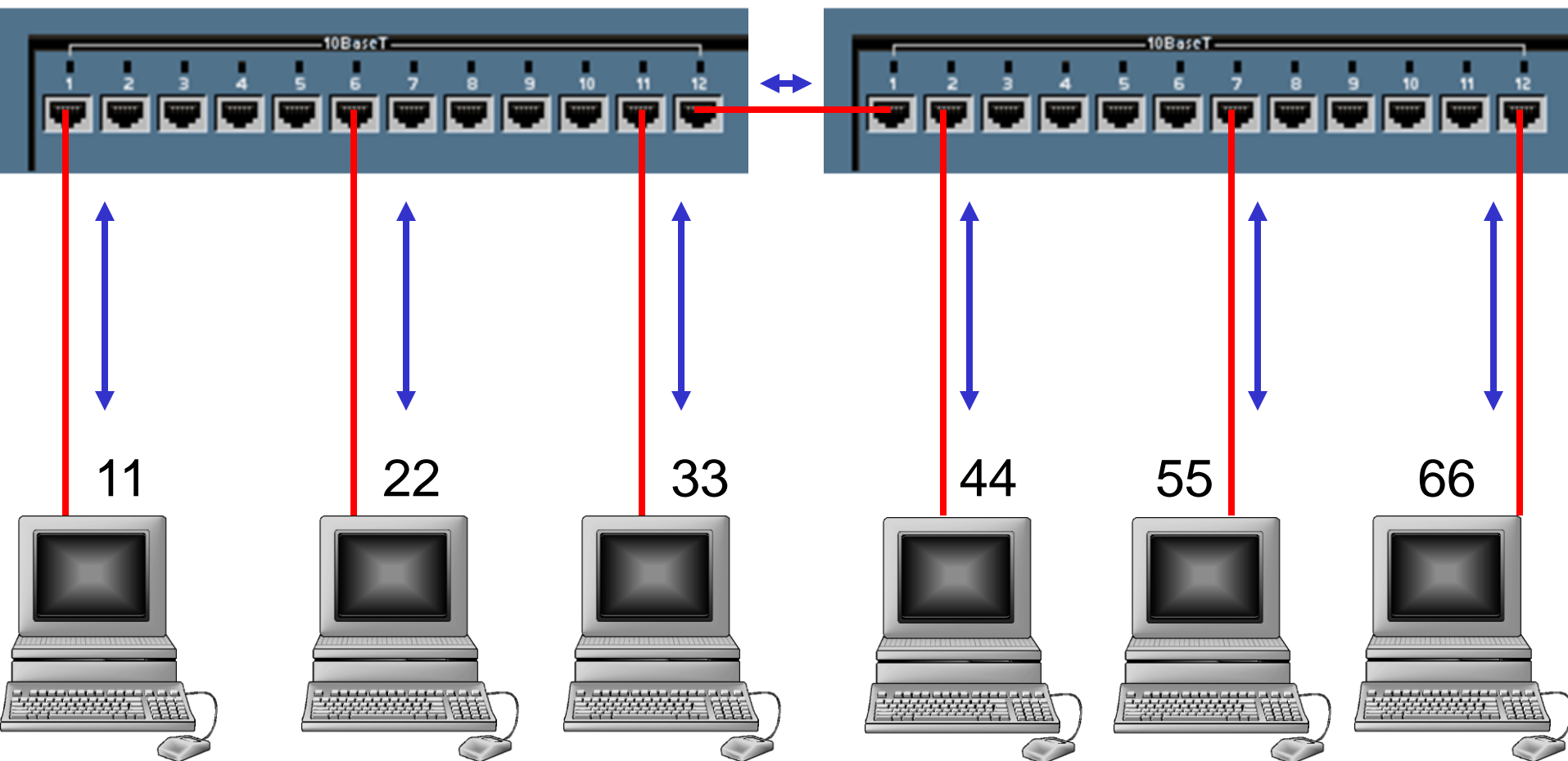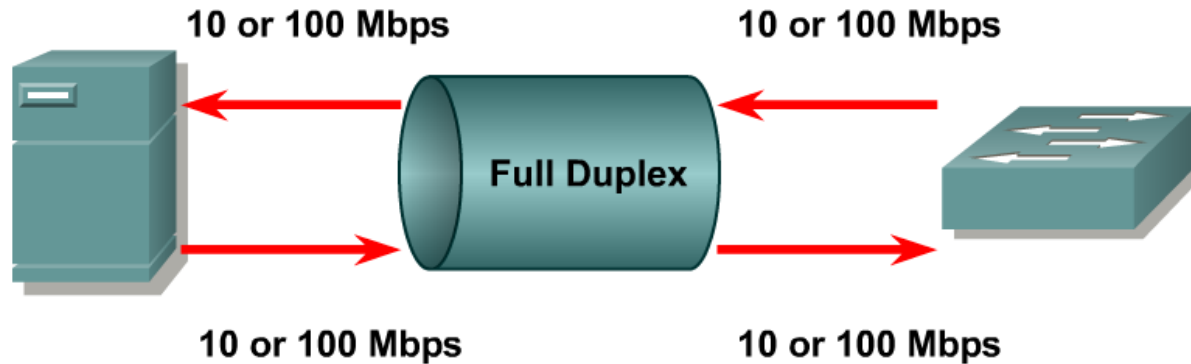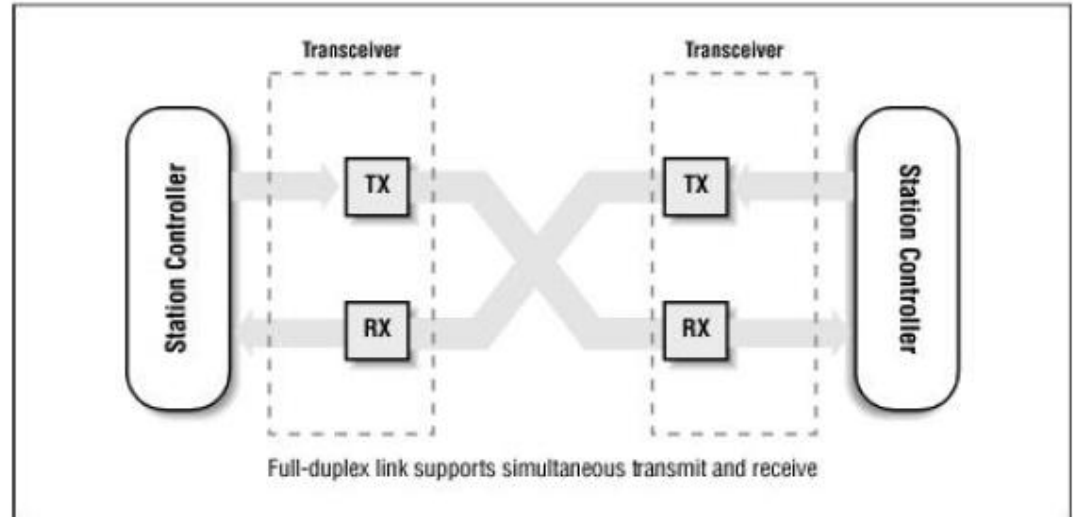
Full-duplex

- **Full-duplex** is an <u>optional</u> mode of operation allowing <u>simultaneous communication</u> between a pair of stations or devices.
- Specified in IEEE 802.3x in March 1997

Full-duplex

10 or 100 Mbps   10 or 100 Mbps

Full Duplex

10 or 100 Mbps   10 or 100 Mbps

- Full-duplex Ethernet allows the transmission of a packet and the reception of a different packet at the same time.
- The full-duplex Ethernet switch takes advantage of the two pairs of wires in the cable by creating a direct connection between the transmit (TX) at one end of the circuit and the receive (RX) at the other end.
- **Half Duplex Ethernet** usually can only use **50%-60%** of the available 10 Mbps of bandwidth because of **collisions** and **latency**.
- **Full-duplex Ethernet** offers **100% of the bandwidth in both directions**.
 - 10 Mbps Ethernet: This produces a potential 20 Mbps throughput, which results from 10 Mbps TX and 10 Mbps RX.

Full-duplex

Full-duplex link supports simultaneous transmit and receive

- **IEEE 802.3x** full-duplex standard requires:
  - The medium must have **independent transmit and receive** data paths that can operate simultaneously.
  - There are **exactly two stations** connected with a full-duplex point-to-point link.
    - There is **no CSMA/CD** multiple access algorithm, since there is no contention for a shared medium.
  - **Both stations** on the LAN are capable of, and have been configured to use, the **full-duplex mode of operation**.
- Ethernet **hubs and repeaters** can only operate in **half-duplex** mode.

Half-duplex Controller

Half-duplex controllers
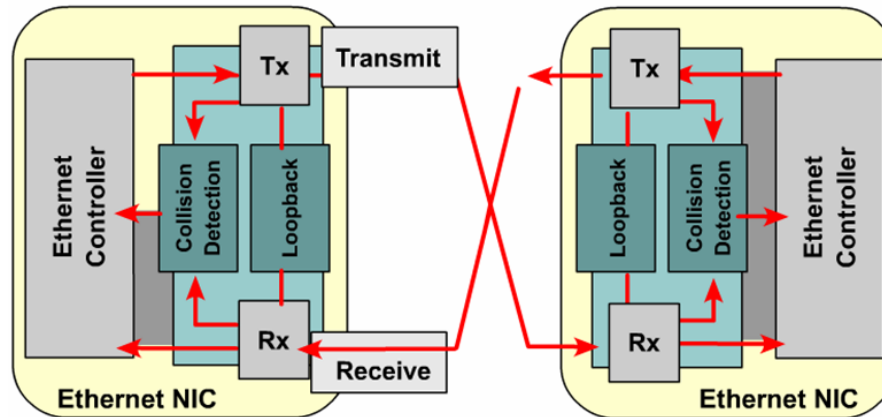
- With **half-duplex** NICs, a host can only **transmit or receive**.
- If the a carrier is detected, then the NIC will not transmit.
- In full-duplex the station ignores the carrier sense and does not defer to traffic being received on the channel.
- In full-duplex, the station ignores any collision detect signals that come from the transceiver.
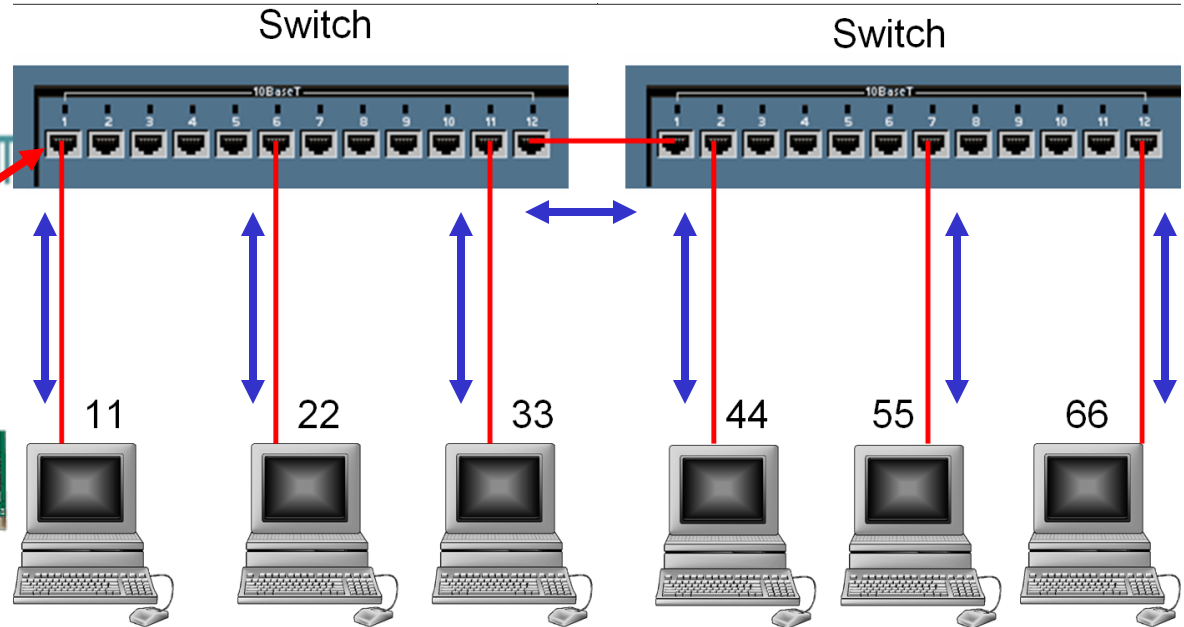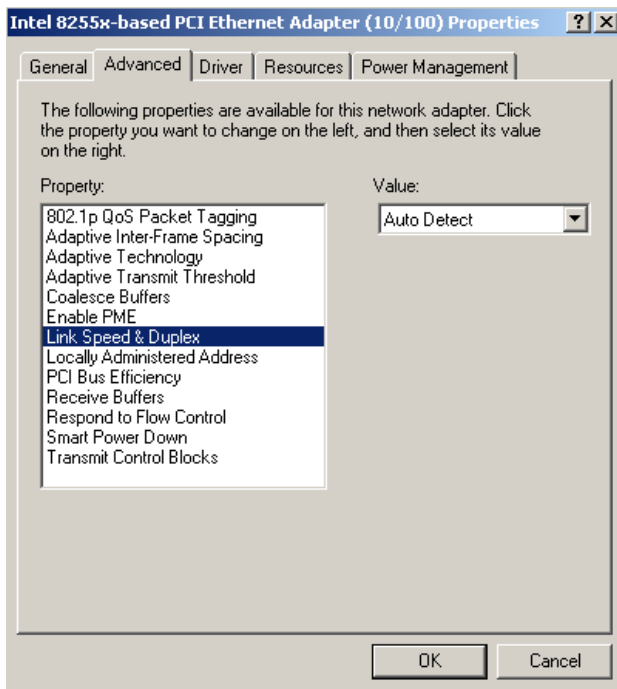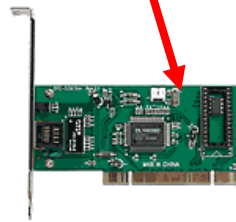- Ethernet hubs and repeaters can only operate in half-duplex mode.

Full-duplex

Ethernet Frame	IFG	Ethernet Frame	IFG	Ethernet Frame	IFG	Ethernet Frame	IFG

- Both half-duplex and full-duplex Ethernet uses an <u>interframe gap (IFG).</u>
- Full-duplex uses the IFG to ensure that the interfaces at each end of the link can keep up with the full frame rate of the link.
- **CSMA/CD not used** in **full-duplex Ethernet**:
  - **No CS (Carrier Sense)** – In full-duplex the station ignores carrier sense since it can *send whenever it likes*.
  - **No MA (Multiple Access)** – Since there is *only one station at the other end of the link* and the Ethernet channel between them is not the subject of access contention.
  - **No CD (Collision Detect)** – Since there is *no access contention*, there will be no collisions, and station can ignore CD.

Full-duplex

Full-duplex

11   22   33   44   55   66

Intel 8255x-based PCI Ethernet Adapter (10/100) Properties

General | Advanced | Driver | Resources | Power Management

The following properties are available for this network adapter. Click the property you want to change on the left, and then select its value on the right.

Property:
- 802.1p QoS Packet Tagging
- Adaptive Inter-Frame Spacing
- Adaptive Technology
- Adaptive Transmit Threshold
- Coalesce Buffers
- Enable PME
- Link Speed & Duplex
- Locally Administered Address
- PCI Bus Efficiency
- Receive Buffers
- Respond to Flow Control
- Smart Power Down
- Transmit Control Blocks

Value:
Auto Detect

OK   Cancel

- There are **exactly two stations** connected with a full-duplex point-to-point link.

- **Both stations** on the LAN are capable of, and have been configured to use, the **full-duplex mode of operation**.

- Typically:
  - Host-to-Switch
  - Switch-to-Switch
  - Switch-to-Router

# When to Use Ethernet 10/100Mb Auto-Negotiation – From www.cisco.com

- **Auto-negotiation** is an optional function of the *IEEE 802.3u Fast Ethernet standard* that enables devices to automatically exchange information over a link about speed and duplex abilities.

- Auto-negotiation is targeted at ports which are allocated to areas where <u>transient users</u> or devices connect to a network.
  - For example, many companies provide shared offices or cubes for Account Managers and System Engineers to use when they are in the office rather than on the road.
  - Each office or cube will have an Ethernet port permanently connected to the office's network.

- Because it may not be possible to ensure that every user has either a 10Mb, a 100Mb Ethernet, or a 10/100Mb card in their laptop, the switch ports that handle these connections must be able to <u>**negotiate their speed and duplex mode**</u>.

- The **alternative** would be to provide both a 10Mb and a 100Mb port in each office or cube and label them accordingly.

When to Use Ethernet 10/100Mb Auto-Negotiation – From www.cisco.com

- **One of the most common causes of performance issues** on 10/100Mb Ethernet links is when one port on the link is operating at half-duplex while the other port is operating at full-duplex.

  - This occasionally happens when one or both ports on a link are reset and the auto-negotiation process doesn't result in both link partners having the same configuration.

  - It also happens when users reconfigure one side of a link and forget to reconfigure the other side.

- Both sides of a link should have auto-negotiation on, **or** both sides should have it off.

- Our **current recommendation** is to leave auto-negotiation on for those devices compliant with 802.3u.

- Many performance-related support calls will be avoided by correctly configuring auto-negotiation.

Half-duplex, Full-duplex Issue

Switch A or Hub A   Switch B

[10BaseT ports diagram]

Half-duplex   Full-duplex
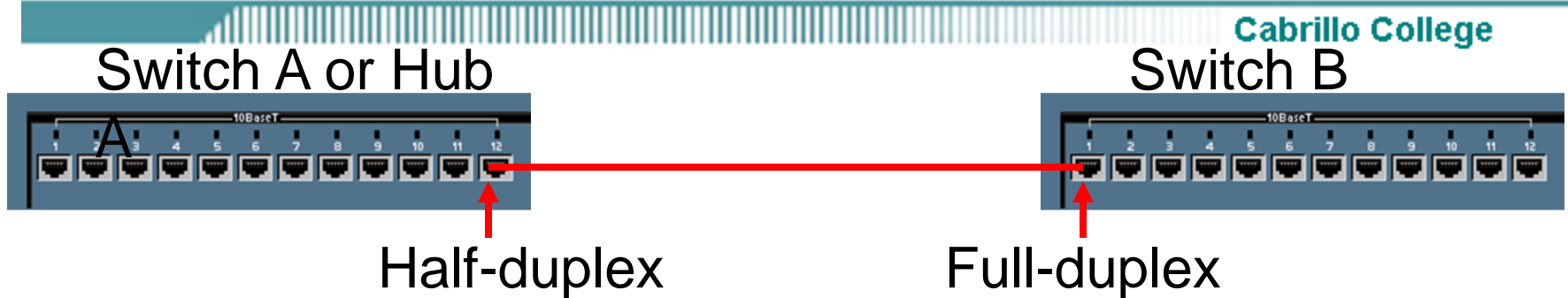
- Switch A, the half-duplex end will sense a neutral carrier and send frames
- Switch B, the full-duplex end, senses the non-neutral carrier and since it doesn't care because it is configured as full-duplex, it transmits anyways.
- Switch A senses a collision (the half-duplex side) and stops sending the frame.
- Switch B (the full-duplex side) doesn't care and keeps on sending frames.
- Data ends up being transmitted only one-way most of the time, with collisions constantly happening on Switch A, causing performance issues on the network. (Remember, most network communications is bi-directional.
- This is also a common cause for **late collisions** (a collision that occurs after the first 512 bits (slot time) have been sent and the sender believes it has acquired the channel.

Make use of www.cisco.com
Lots of good information!

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